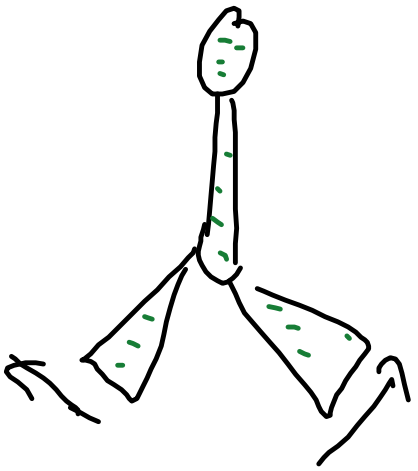
Electrostatics (ch 16-17 Giancoli)

Charges that are not moving.
Charge, q or Q, is some property of matter that causes a force with other charged objects.

If charge is put on an electroscope (two thin leaves - gold leaves works best) the leaves move apart.



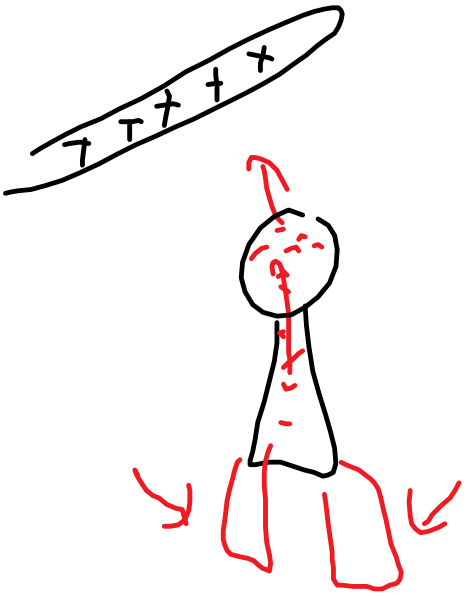
Vinyl ← negative

glass ← positive

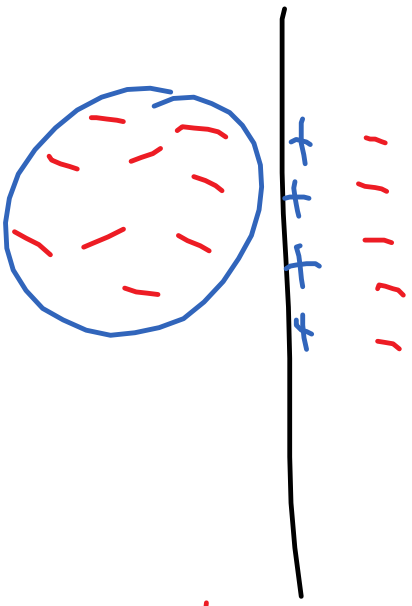
Ben Franklin decided

like charges repel
opposites attract

What about neutral objects?
Macroscopic neutral object - the wall
Near a charged object - balloon



null
neutral



Positive charges attract more strongly because they are closer

Colombs law

raall gravity $F_g = mg = \frac{G M m}{r^2}$

recall gravity $F_g = mg = \frac{GMm}{r^2}$

Electrostatics $F_e = qE = \frac{kQq}{r^2}$

F_e is the electrostatic force, the attraction or repulsion between charges, Q and q.
Q is the charge creating the electric field E.
q is a small test charge.
E is electric field strength, F/q the force per unit charge on a small positive test charge, q.
r is the distance between the point charges, or the centres of conducting spheres.

k is coulomb's constant, 8.99×10^9 $Nm^2 C^{-2}$

C is a coulomb, defined in terms of the Ampère. Historically Coulomb is a derived unit while Ampère is a SI base unit. A is a unit of electric current, C/s.

Current, I=Q/t

Eg. A hydrogen atom is an electron "orbiting" a proton. The radius of the atom is 0.50 Å = 5.0×10^{-11}m

If the elementary charge, e is 1.602×10^{-19}C determine

a) The force between the charges
b) The velocity of the electron if it is in uniform circular motion around the proton
   Me =9.11×10^{-31}kg

P437 Problems 1-13 odds.

Electrostatics (Chapters 16 and 17 Giancoli)

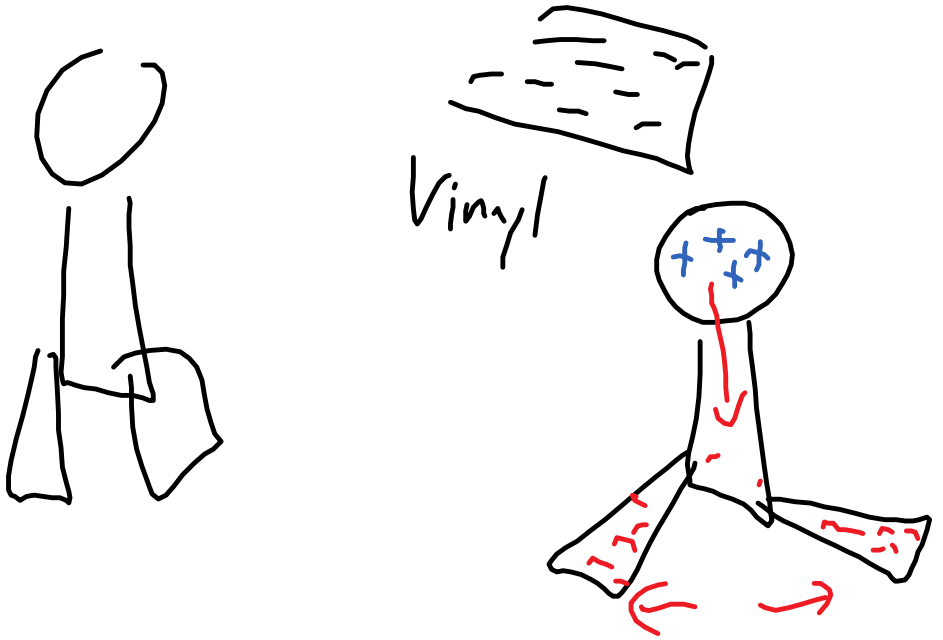
Charges at rest.

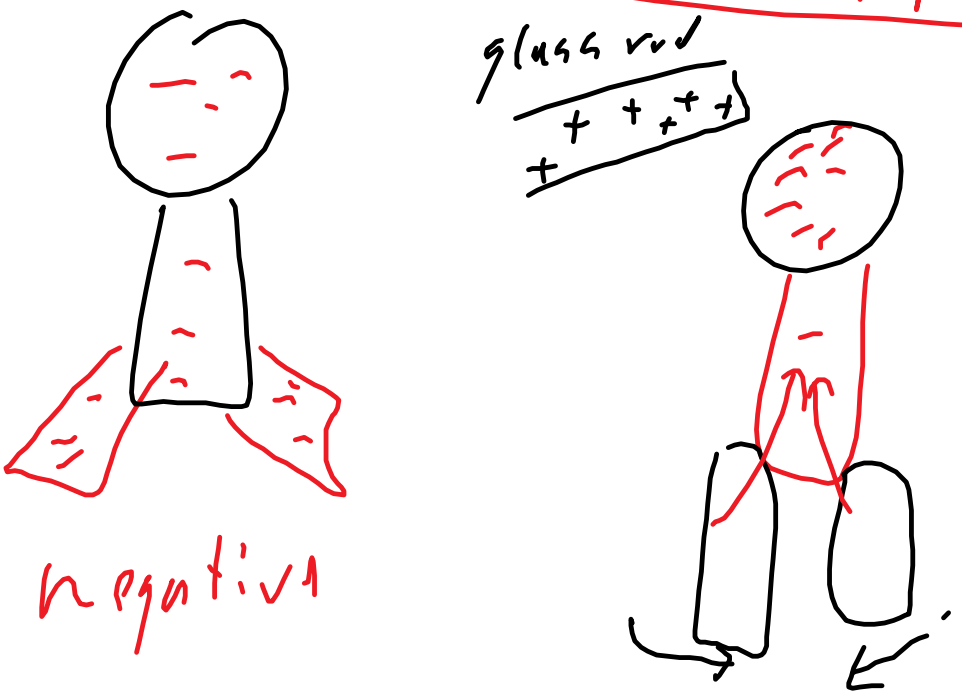
Charge, Q or q, is a property of some elementary particles (quarks, electrons, muons, taus, electroweak bosons)
Neutral elementary particles (neutrinos, Higgs, photons, Z bosons, gluons)

There is positive and negative charge.
Like charges repel
Opposites attract
Neutral objects - elementary particles ignore charge
Macroscopic neutral objects can be attracted to charged objects (see later notes)

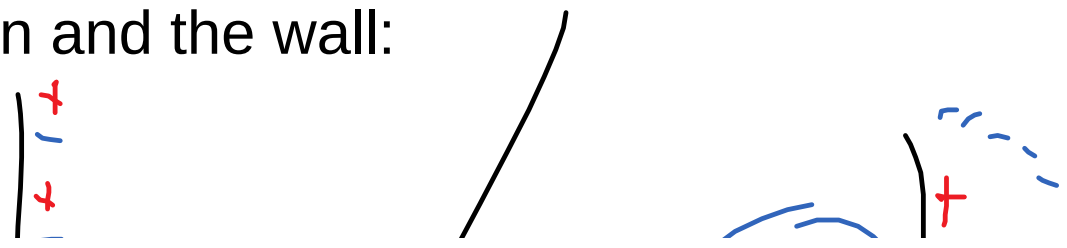
History - Ben Franklin decided that when you rub a vinyl strip it is charged negative and a glass rod is charged positive (usually but depends on what you are rubbing with). This was arbitrary.

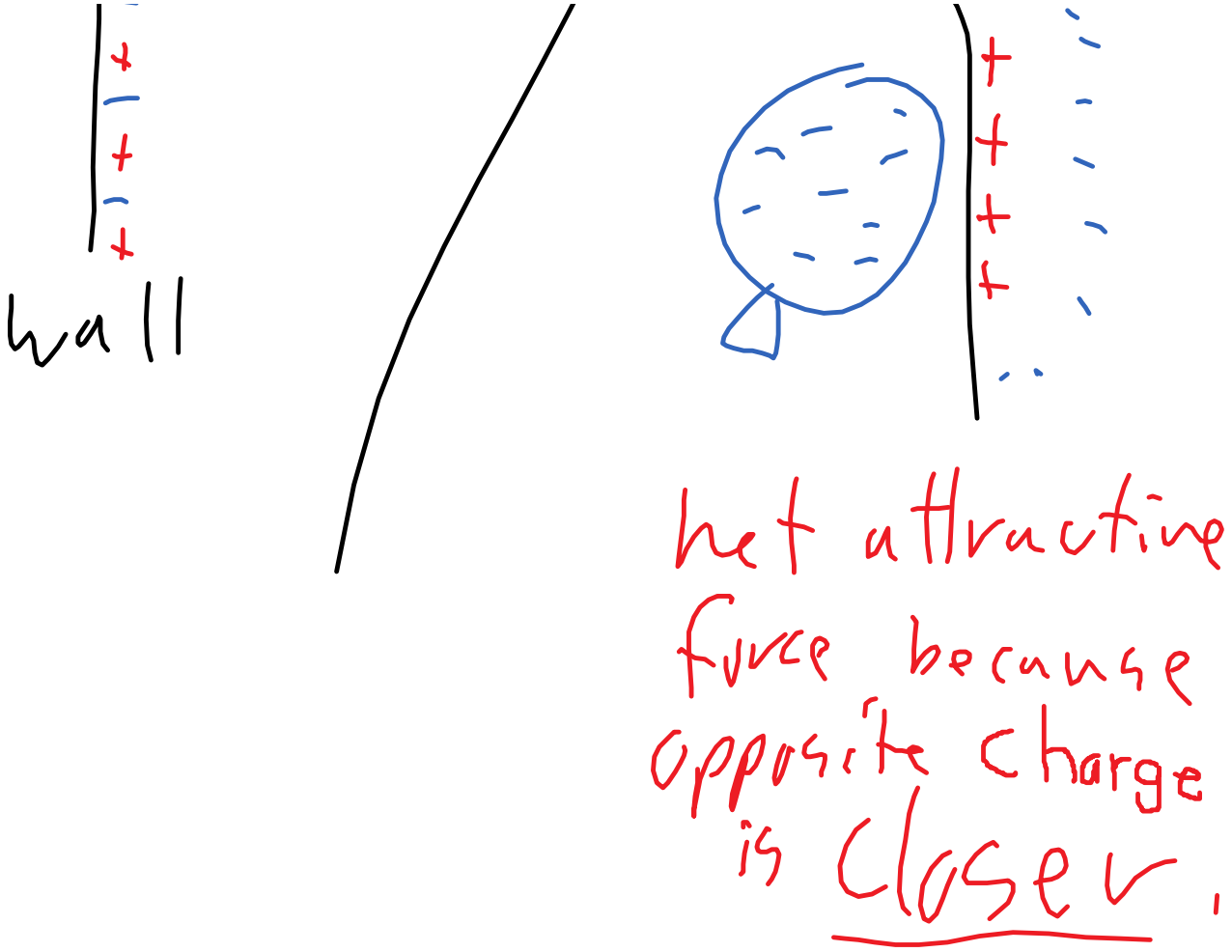
Electroscope - a metal ball connected to thin conducting leaves (the best are made of gold)





Balloon and the wall:





Coulomb's Law
From the balloon experiment we know that electrostatic force, F_e, is greater over shorter distances and with more charge.

recall for gravity
$F_g=mg=GMm/r^2$
Same thing for electrostatics
$F_e=qE=kQq/r^2$
F_e is the electrostatic force, attractive for opposite charges, repulsive for like charges.

Q and q are two charges, measured in Coulombs, C. (not an SI base unit, historically defined in terms of the Ampère=C/s)

Elementary charge, $e = 1.602 \times 10^{-19}C$

E is electric field strength, E=F/q the force per unit charge on a small positive test charge.
Units: N/C

r is the distance between the point charges or the centres of two charged conducting spheres (assuming the charge doesn't redistribute itself)

k is Coulomb's constant $8.99 \times 10^{9}\ Nm^2C^{-2}$
$= 1/(4\pi\varepsilon)$
ε is the permittivity of free space

Eg. A hydrogen atom is an electron "orbiting" a proton. The radius of the atom is 0.50 Å = $5.0 \times 10^{-11}m$

If the elementary charge, e is $1.602 \times 10^{-19}C$ determine

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P437 Q1-13 odds